

Emotional Agents

Autonomous Agents and MultiAgent Systems

2015/2016

Ana Paiva



Emotions...



... in other species



In communication



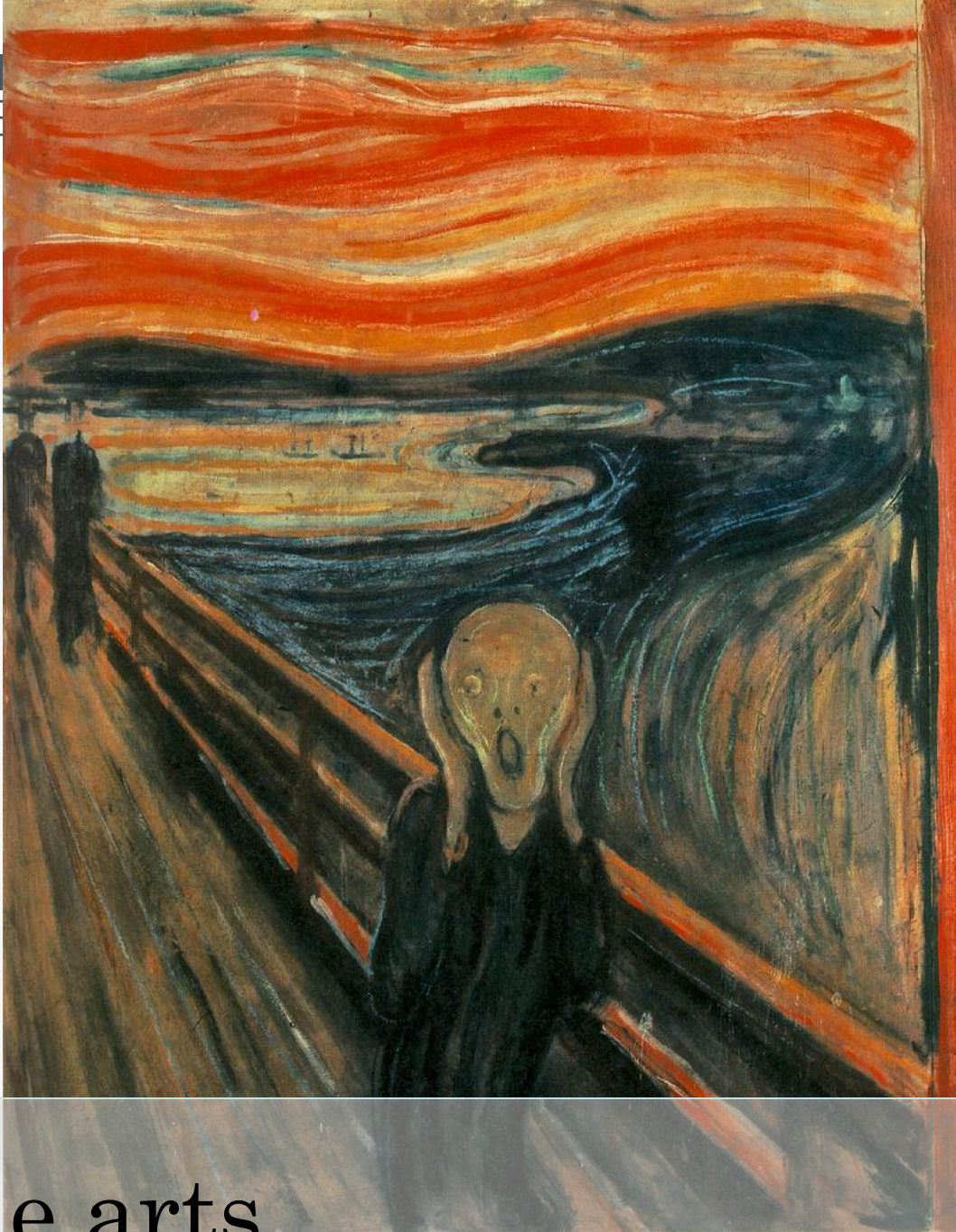
In the establishment of social relations



Promotes collaboration



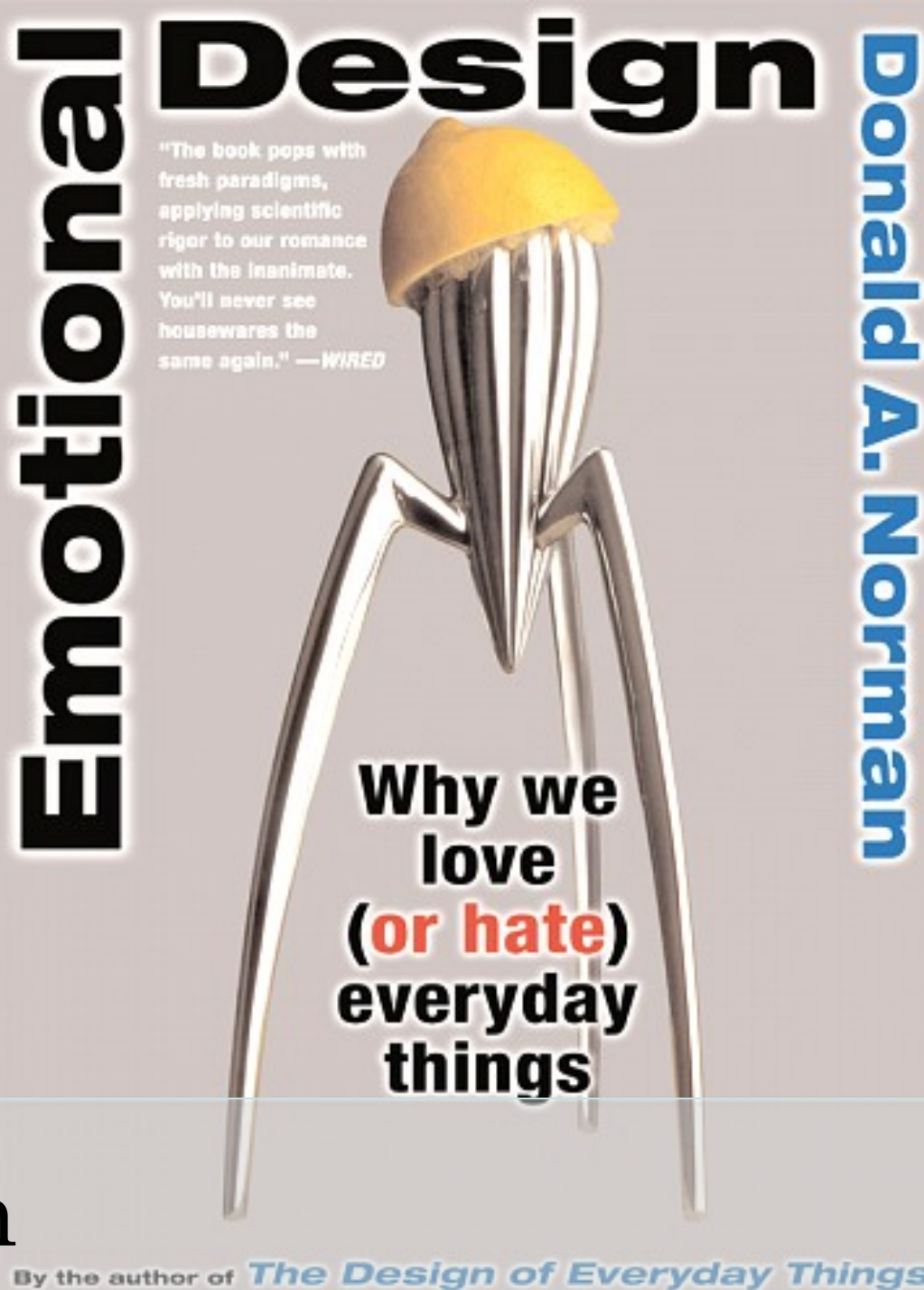
Helps negotiations



In the arts

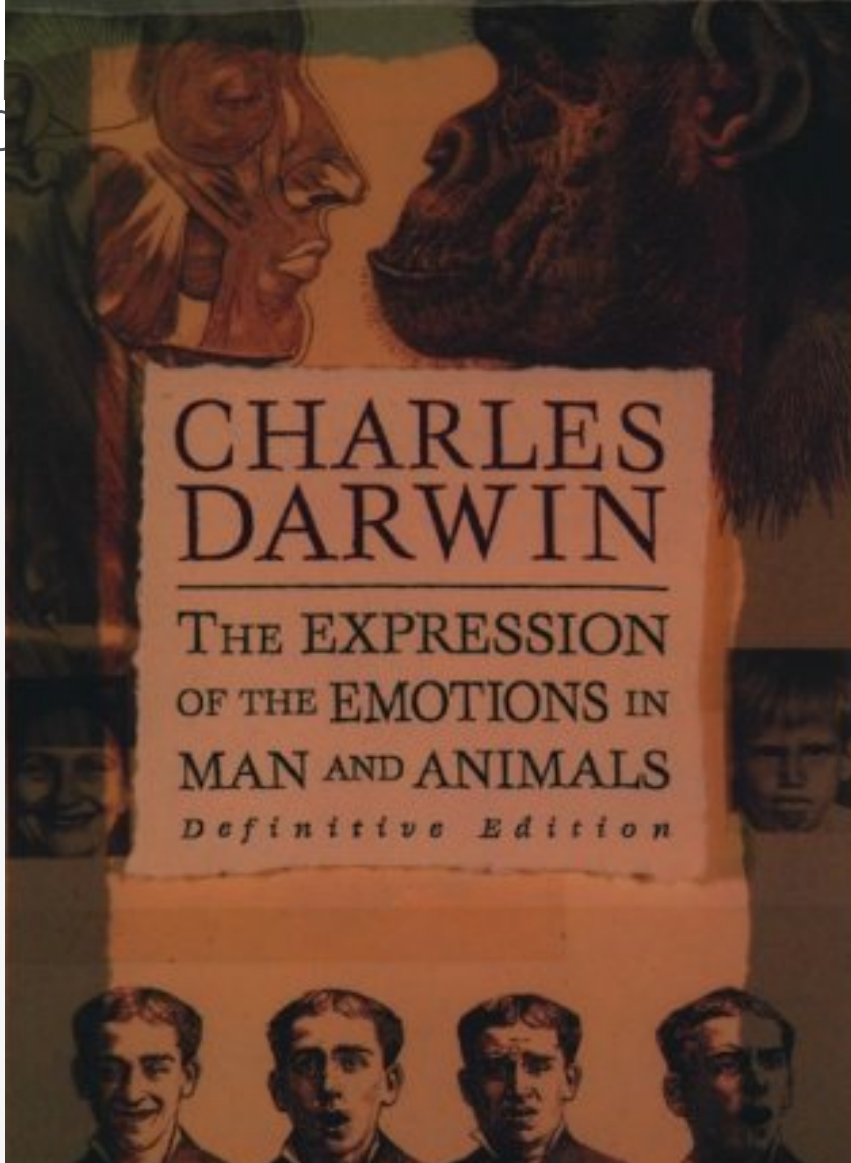


TÉCNICO
LISBOA



In design

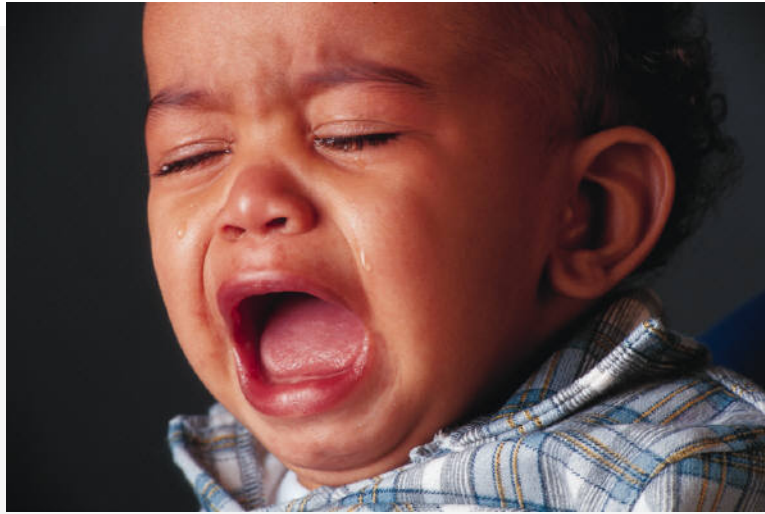




Our descent, then, is the origin of our evil passions!- Charles Darwin, textbook, Gruber & Barrett, 1974, p. 289

What are emotions?

- “a conscious mental reaction (as anger or fear) subjectively experienced as strong feeling usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body.” *[Dictionary MerrianWebster]*
- But understanding emotions is difficult...
 - After a century of research, there is still no consensus about what are emotions and how to communicate them [Picard]



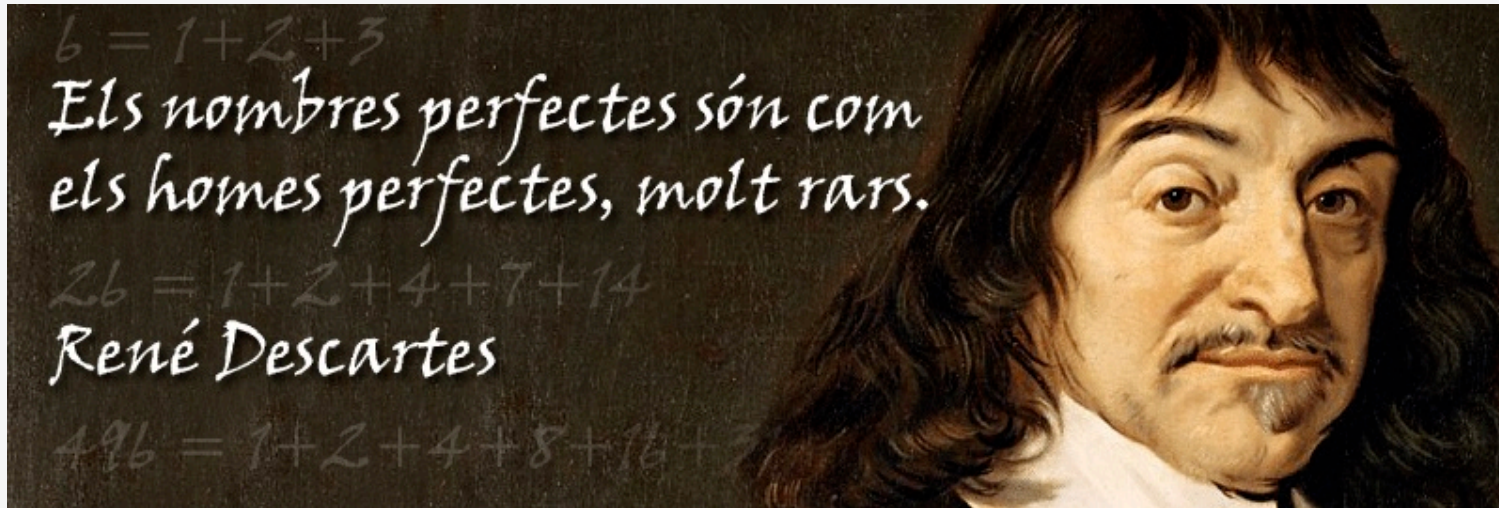
- A feeling that underlies behaviors and comprised of
- **Physiological** (autonomic arousal)
 - **Behavioral** (non-verbal expression)
 - **Cognitive** (subjective feelings)

Why study emotions?

- Research on Human Sciences shows the importance of emotions in human behaviour
 - [Damasio] emphasizes this aspect of human behaviour
 - Creativity and emotion are strongly related.
 - Memory and emotion are strongly related
- Plus, Human-Technology interaction is naturally social and as such, emotion should be a part of it.



Descartes' error



- According to Descartes(1569-1650) there was a clear separation between the rational and the irrational.
- [Damasio] defends that reason and emotion cannot be seen as antagonistic entities in our mind.

Early Theories of Emotion

Common Sense View

- When you become happy, your heart starts beating faster. First emotion, then physiological activity



James-Lange Theory (1884)



Stimulus → Response (heart rate, etc) → Emotion

- Emotion is a *result* of physiological responses to stimuli
- We are sad because we cry, afraid because we tremble . . .

Responses precede emotions

Situation > Interpretation of the brain > Physiological Reaction > Cognition > Emotion

James-Lange theory

Testing the theory:

- **Hypothesis 1:** You need the body in order to feel emotions.
- **Test:** Interview people with high vs. low spinal cord injuries

High spinal cord injury:

“Sometimes I act angry... But it doesn't have the heat to it that it used to. It's a mental kind of anger.”

James-Lange theory

- Situation



→ bodily reaction



→ emotion



James-Lange theory

- Testing the theory:
- Hypothesis 1: You need the body in order to feel emotions
 - Results 1: The body may be necessary to have a full emotional experience.
- Hypothesis 2: The body can tell you precisely which emotion to feel.
 - Test: Gave people a dose of adrenaline:
“I feel *as if* I’m angry or afraid”

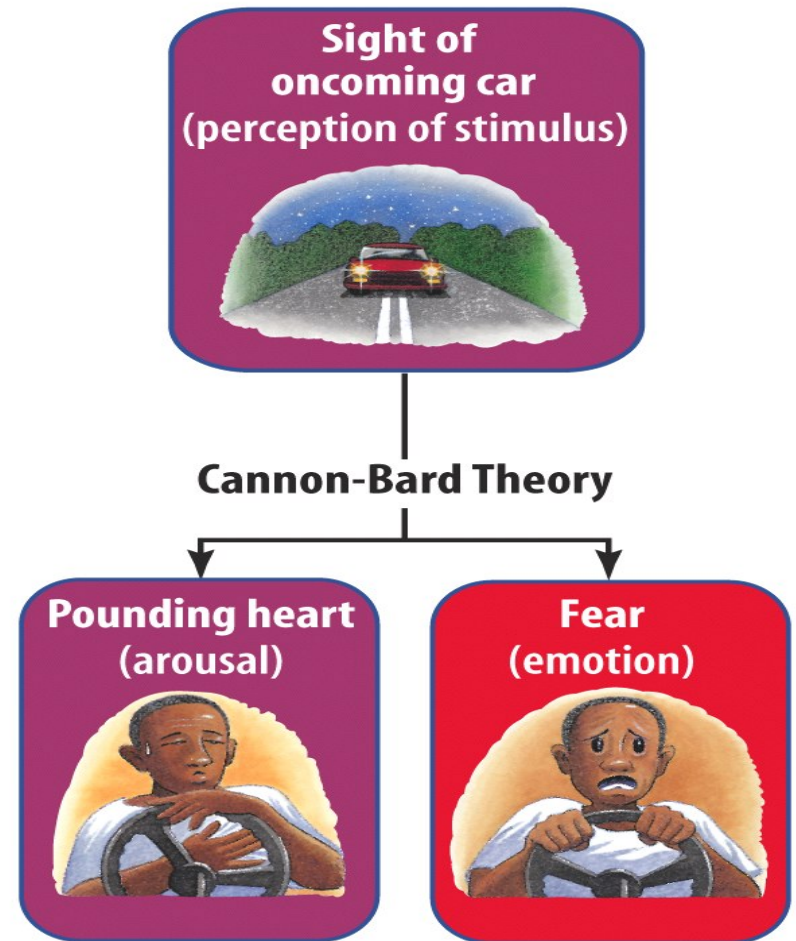
James-Lange theory

Testing the theory:

- Hypothesis 1: You need the body in order to feel emotions
 - ***Results 1: The body may be necessary to have a full emotional experience.***
- Hypothesis 2: The body can tell you precisely which emotion to feel.
 - ***Results 2: The body is not **ALL** that is necessary to have a fully emotional experience.***

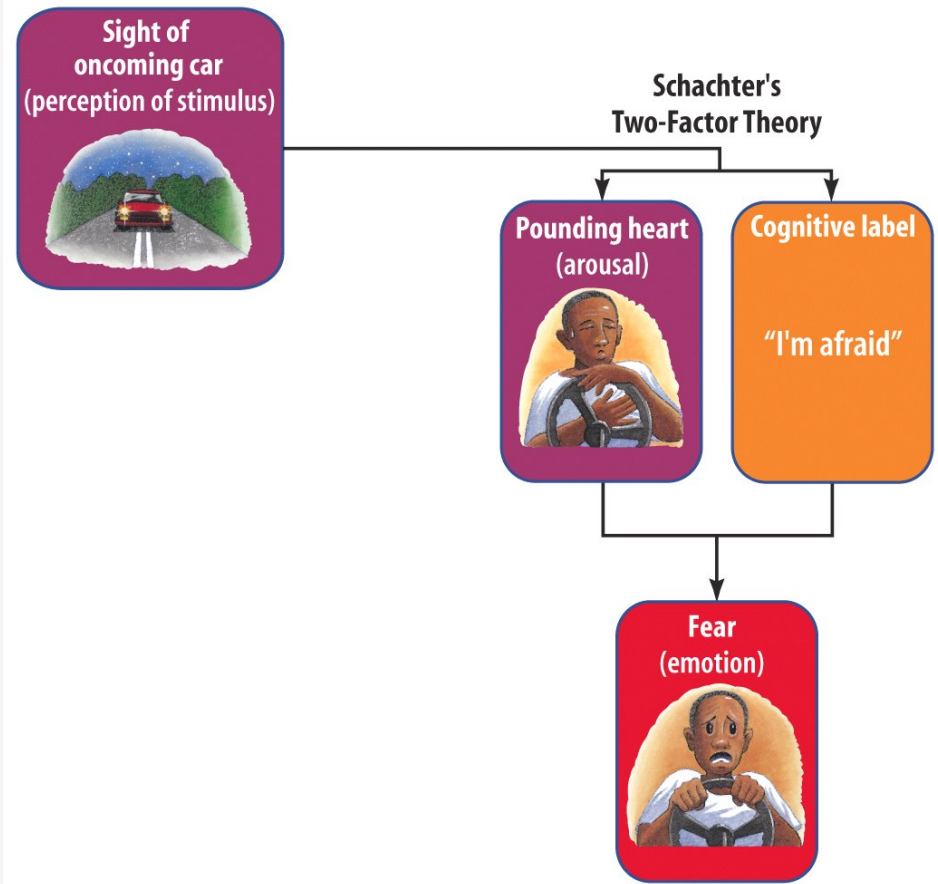
Cannon-Bard Theory of Emotion

- Physiological arousal and emotion (subjective feelings) occur simultaneously
- Heart begins pounding as we experience fear



Schachter-Singer Theory

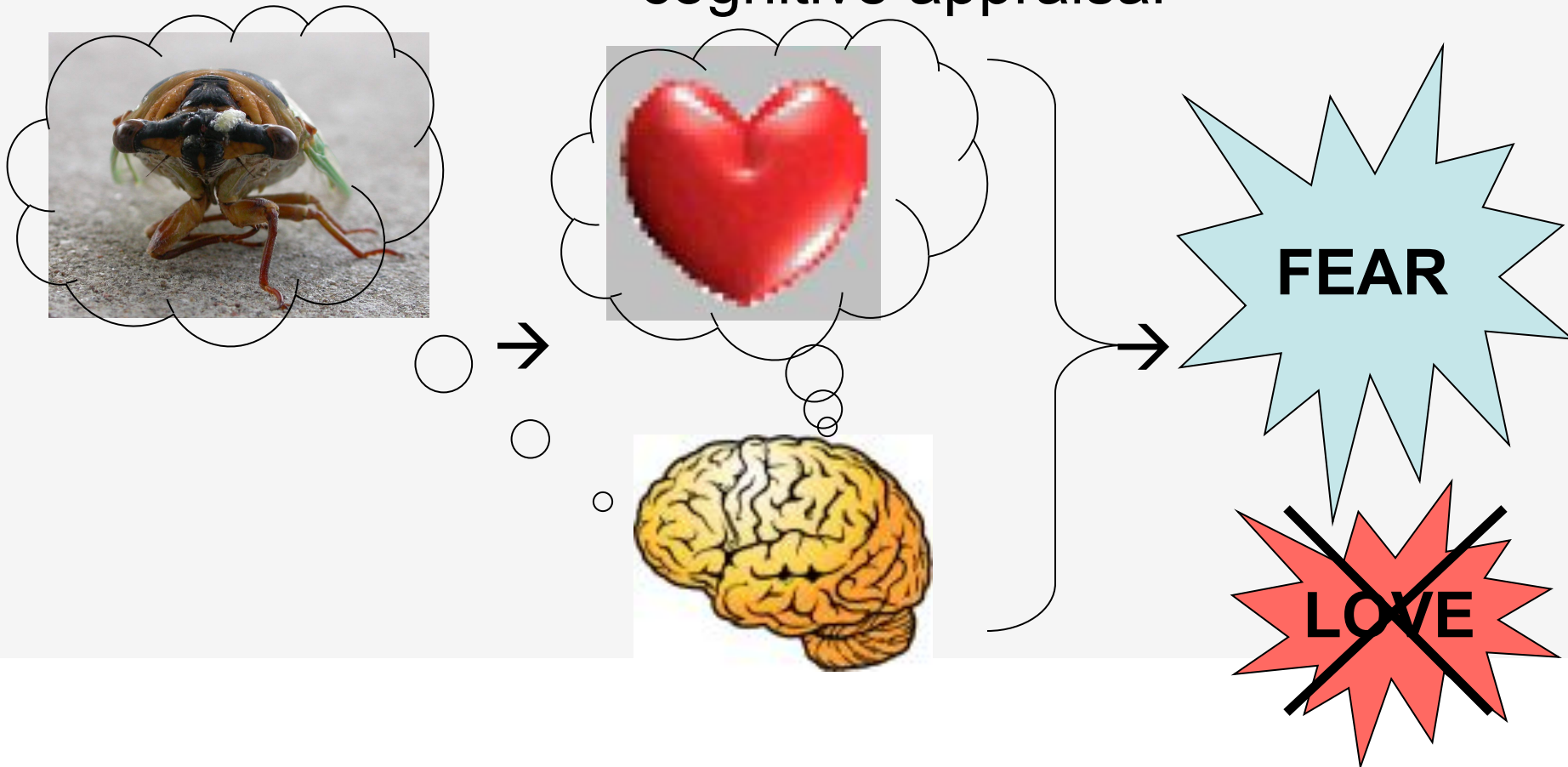
Stanley Schachter and Jerome Singer proposed yet another theory which suggests our physiology and cognitions create emotions. Emotions have two factors—physical arousal and cognitive label.



3. The Schachter theory

- Situation

→ bodily reaction → emotion
+ cognitive appraisal



Characteristics of Emotion

Dimensions of emotion
(valence and arousal)

- Function and structure
 - Emotion as a “motivator”
 - Facial feedback hypothesis
(e.g. Ekman, Levenson, & Friesen, 1983)
 - Action tendencies (Frijda, 1986)



Paul Ekman's Research on Emotions

- **Primary** Emotions
 - 1) Are evident in all cultures
 - 2) Are based in survival
 - 3) Correlate with facial expressions
- **Secondary** All other emotions that are particular to humans and specific cultures
- Six primary emotions **happiness, surprise, sadness, fear, disgust** and **anger** (and degrees) **Ekman**



Neutral



Anger



Disgust



Fear

Paul Ekman
on the
universality
of Emotions



Joy

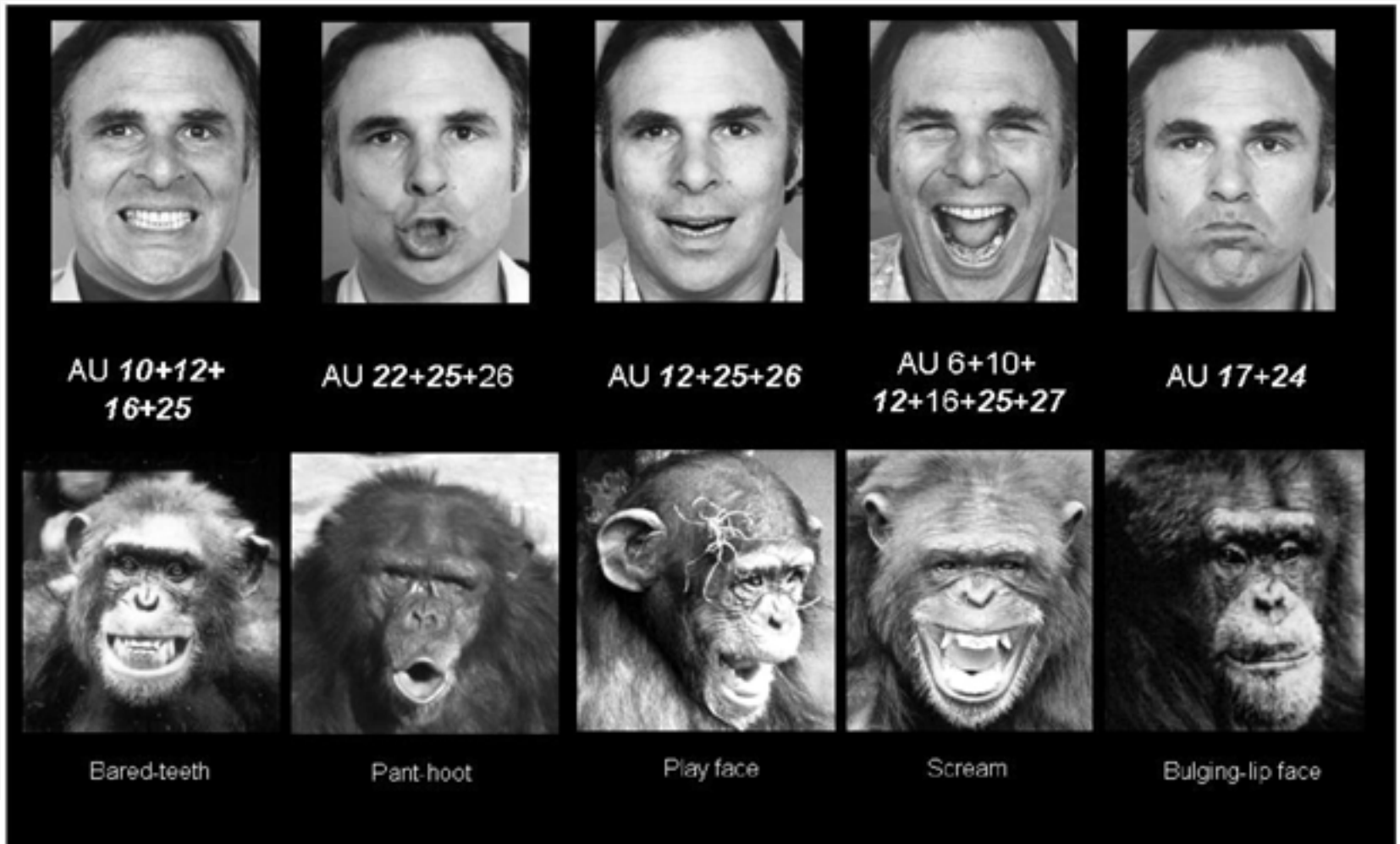


Sadness



Surprise

Paul Ekman: FACS



Different Theories: Basic Emotions

	Basic Emotions	Basis for Inclusion
Arnold	Anger, aversion, courage, dejection, desire, despair, fear, hate, hope, love, sadness	Relation to action tendencies
Ekman, Friesen e Ellsworth	Anger, disgust, fear, joy, sadness, surprise	Universal facial expressions
Frijda	Desire, happiness, interest, surprise, wonder, sorrow	Forms of action readiness
Gray	Rage and terror, anxiety, joy	Hardwired
James	Fear, grief, love, rage	Bodily involvement
Mowrer	Pain, pleasure	Unlearned emotional states
Panksepp	Expectancy, fear, rage, panic	Hardwired
Watson	Fear, love, rage	Hardwired

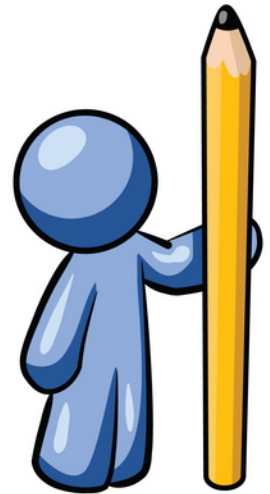
Appraisal Theories: Cognition and Emotion

What is the connection between how we
think (cognition) and how we *feel*
(emotion)?

Can we change our emotions by changing
our thinking?

Appraisal Theories

- Appraisal characterizes the assessment of the relationship between the person and their physical and social environment.
- This appraisal is clearly subjective and is made regarding the agent's desires, goals, standards, values, and attitudes.



Situation> Interpretation> Evaluation (appraisal)
> Emotion

Cognitive-Appraisal Theory

- Sequence
 - Situation/Stimulus (object, event, or thought)
 - Appraisal of how this affects your well-being (consciously or unconsciously)
 - Emotion (fear, anger, happiness, ...)
 - Physiological responses and behavior
- For an emotion to occur, it is necessary to first think about the situation.

Why Appraisal Theories?

- Appraisal Theories:
 - Emotions are preceded and *generated by a cognitive appraisal*
 - The appraisal system has evolved to *predict the most adequate* response to a situation and elicit the *appropriate emotion*

Affective Computing and Agents: Common Goals

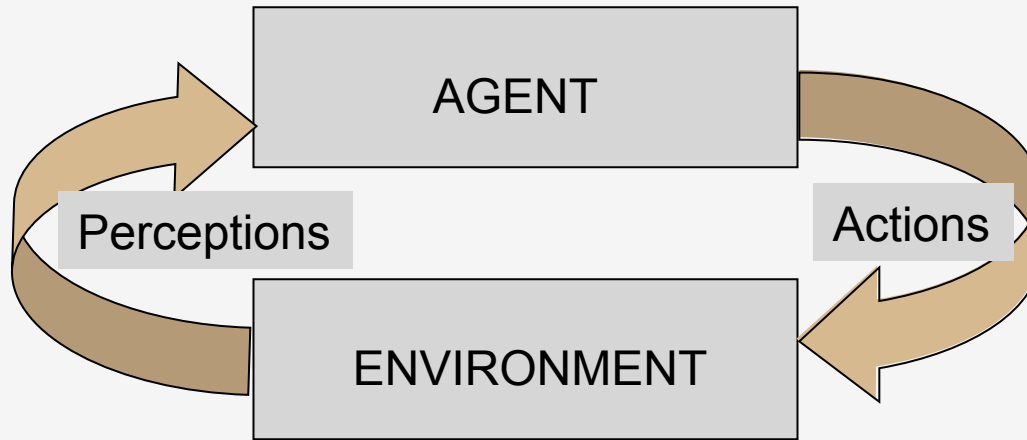
1. To make machines less frustrating to interact with
 - *Interface agents*
 - *Agents that interact with humans*
2. To conceive robots and synthetic characters that can emulate humans or animals
 - *Believability of agents*
3. To study human emotions by modeling them
 - *Psychological and social simulations*
4. To improve machine intelligence
 - *More intelligent and resource-effective agents*

Emotional Agents

- Aspects to consider
 - Emotional Perception
 - Emotional Reasoning
 - Emotional Memory
 - Emotional Learning
 - Emotional Expression



Emotional Agents



- How to define an agent that is emotional?

Emotional Agents



An emotional agent is an agent that interacts with its environment *based on valenced evaluations* of the *impact that the states* of that environment have on the goals, beliefs and overall *concerns* of that agent.

Relating with the Existing Architectures



- Reactive Architectures
- Deliberative Architectures
- Hybrid Architectures

Relating with the Existing Architectures

- Emotions will have an impact on:
 - *Perception* (the *see* function)
 - *Beliefs* (the *brf* function)
 - *Reasoning and Decision Making*
(deliberation and means-ends reasoning)
 - *Action and Expression*



Agent Control Loop Version 7

```
1.
2.   $B := B_0;$ 
3.   $I := I_0;$ 
4.  while true do
5.      get next percept  $\rho$ ;
6.       $B := brf(B, \rho);$ 
7.       $D := options(B, I);$ 
8.       $I := filter(B, D, I);$ 
9.       $\pi := plan(B, I);$ 
10.     while not ( $empty(\pi)$ 
                  or  $succeeded(I, B)$ 
                  or  $impossible(I, B)$ ) do
11.          $\alpha := hd(\pi);$ 
12.          $execute(\alpha);$ 
13.          $\pi := tail(\pi);$ 
14.         get next percept  $\rho$ ;
15.          $B := brf(B, \rho);$ 
16.         if  $reconsider(I, B)$  then
17.              $D := options(B, I);$ 
18.              $I := filter(B, D, I);$ 
19.         end-if
20.         if not  $sound(\pi, I, B)$  then
21.              $\pi := plan(B, I)$ 
22.         end-if
23.     end-while
24. end-while
```




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23.     end-while
24. end-while
```

Affective
Sensing



Agent Control Loop Version 7

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23.     end-while
24. end-while
```

Affective
Revision



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```

Appraisal



Agent Control Loop Version 7

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24. end-while
```

Affective
Deliberation



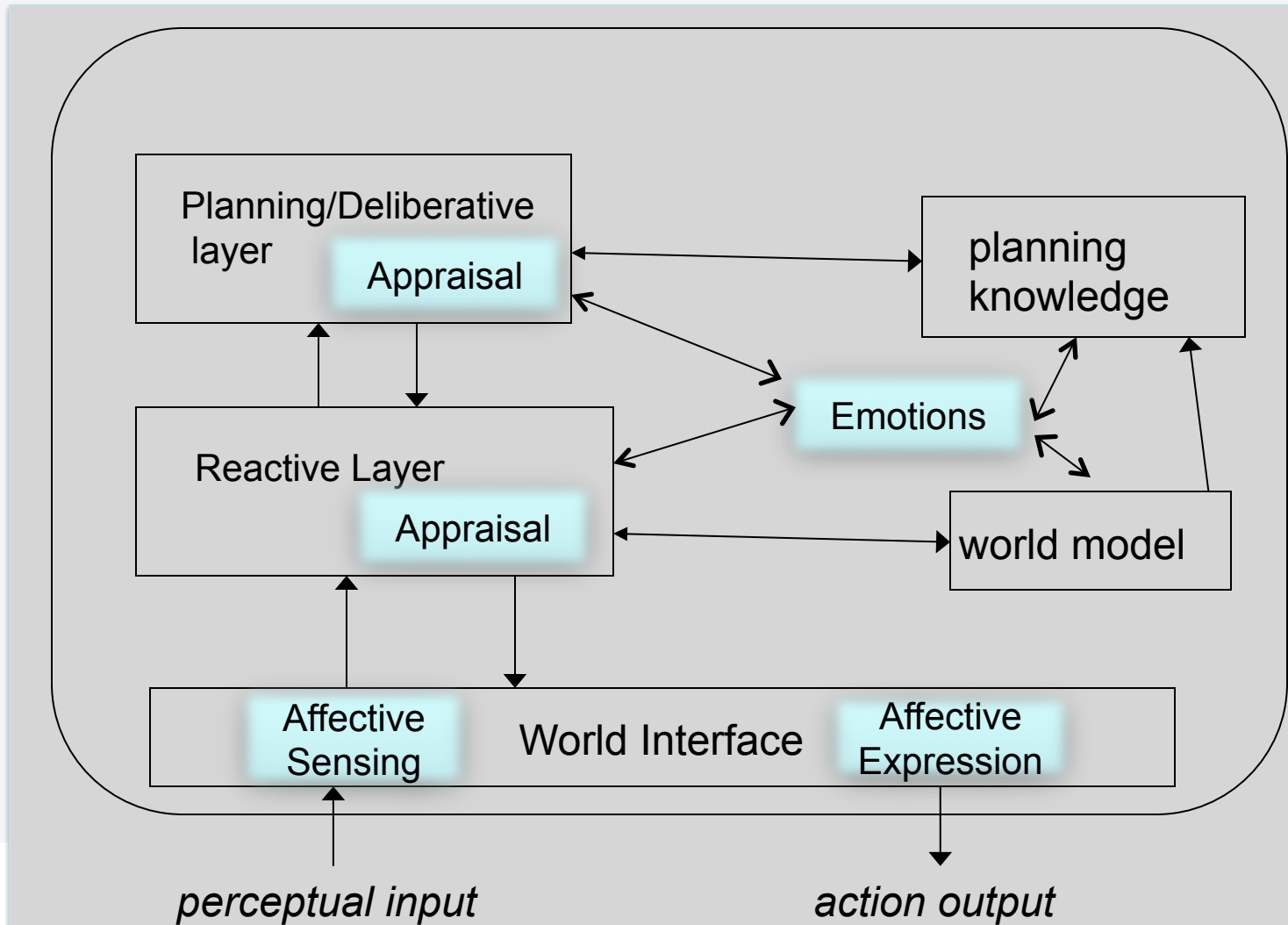
Agent Control Loop Version 7

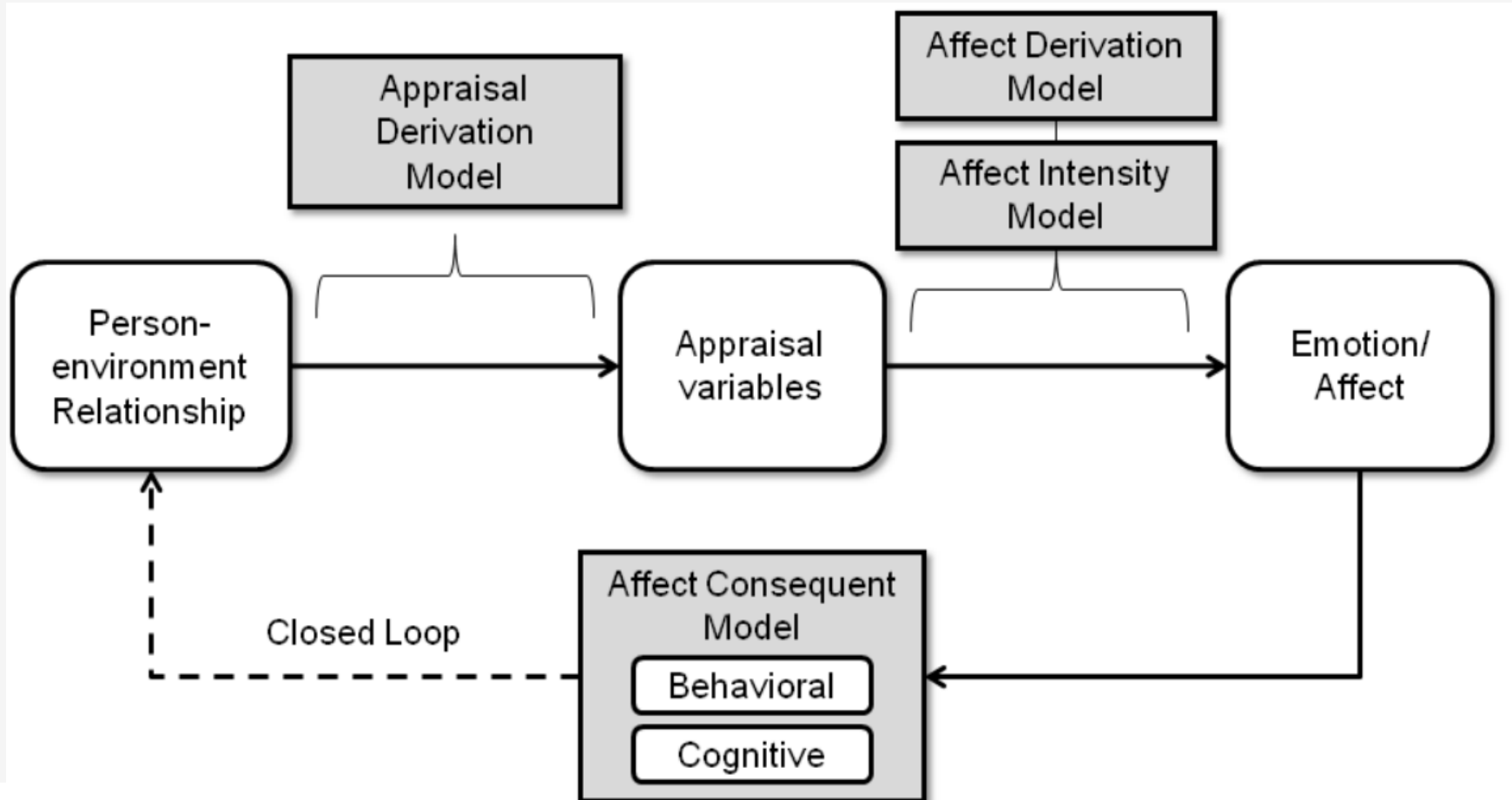
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```

Expression

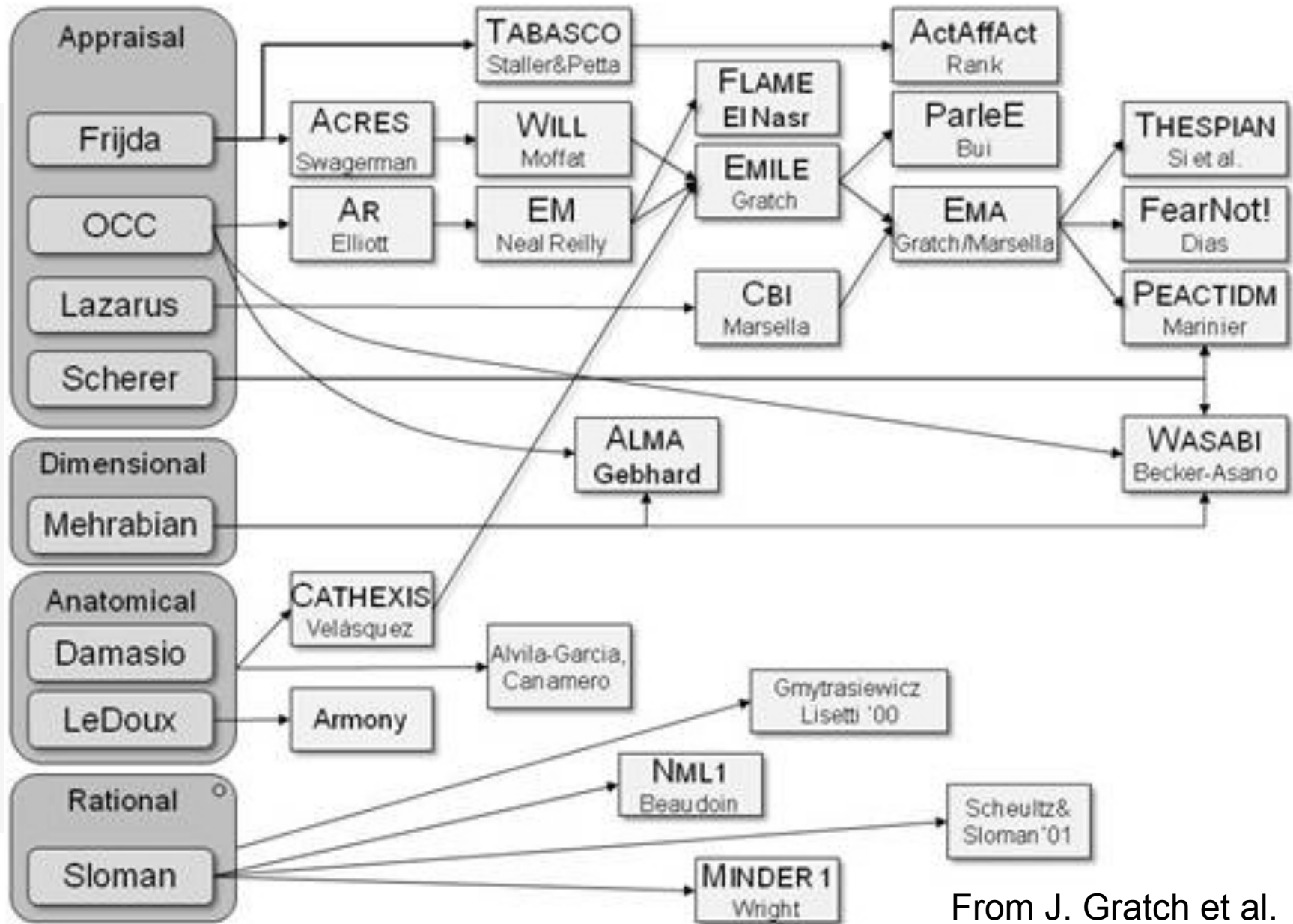
What about the reactive
dimension of emotion?

Emotional Agents as Hybrid Architectures





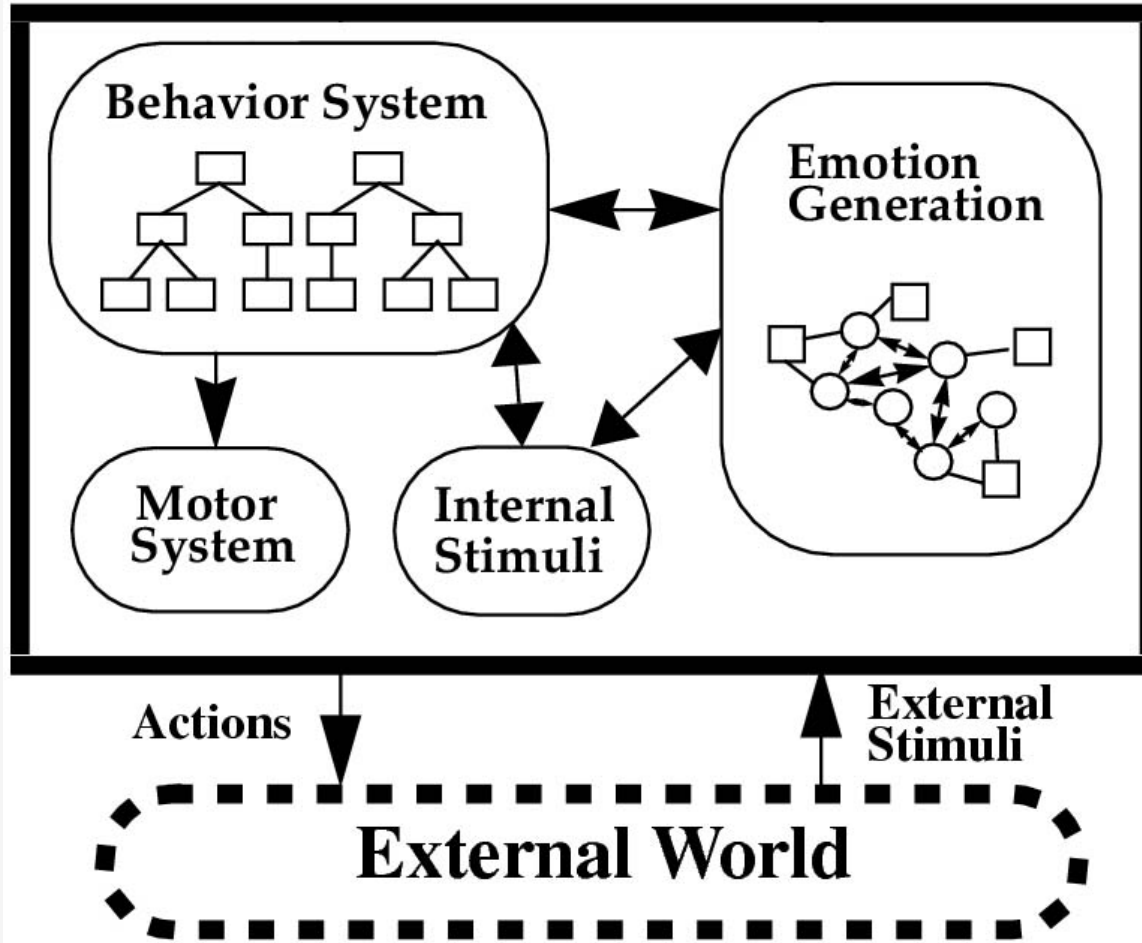
Existing Emotional Architectures



From J. Gratch et al.

Some Examples

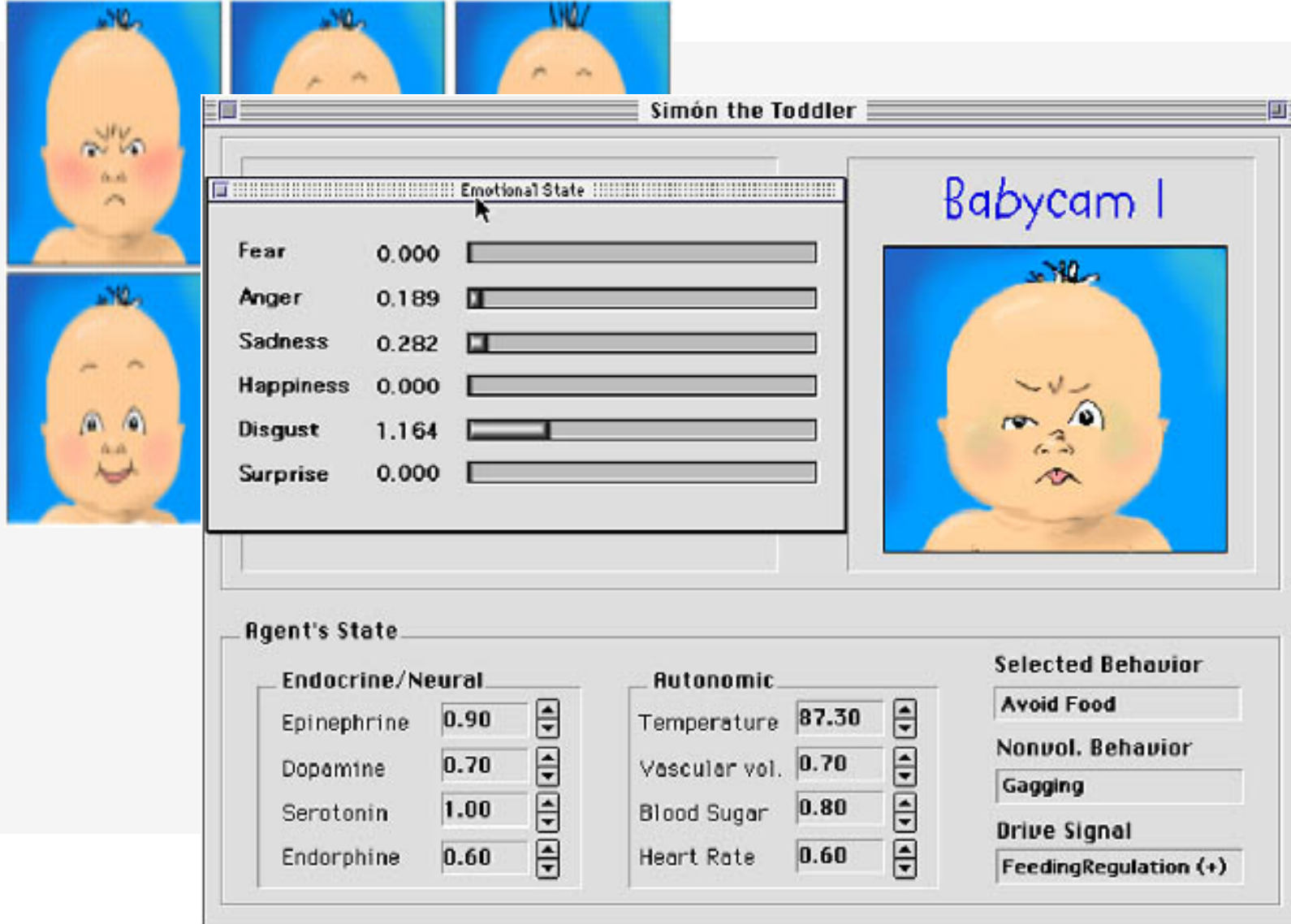
Cathexis



Cathexis

- Basic Emotions
 - *Anger*
 - *Fear*
 - *Sadness*
 - *Joy*
 - *Disgust*
 - *Surprise*
- Basic emotions are *families of emotional states*
(e.g. *Fear*, *Terror*, *Panic*, are from the *Fear* family)

Simón, the Toddler



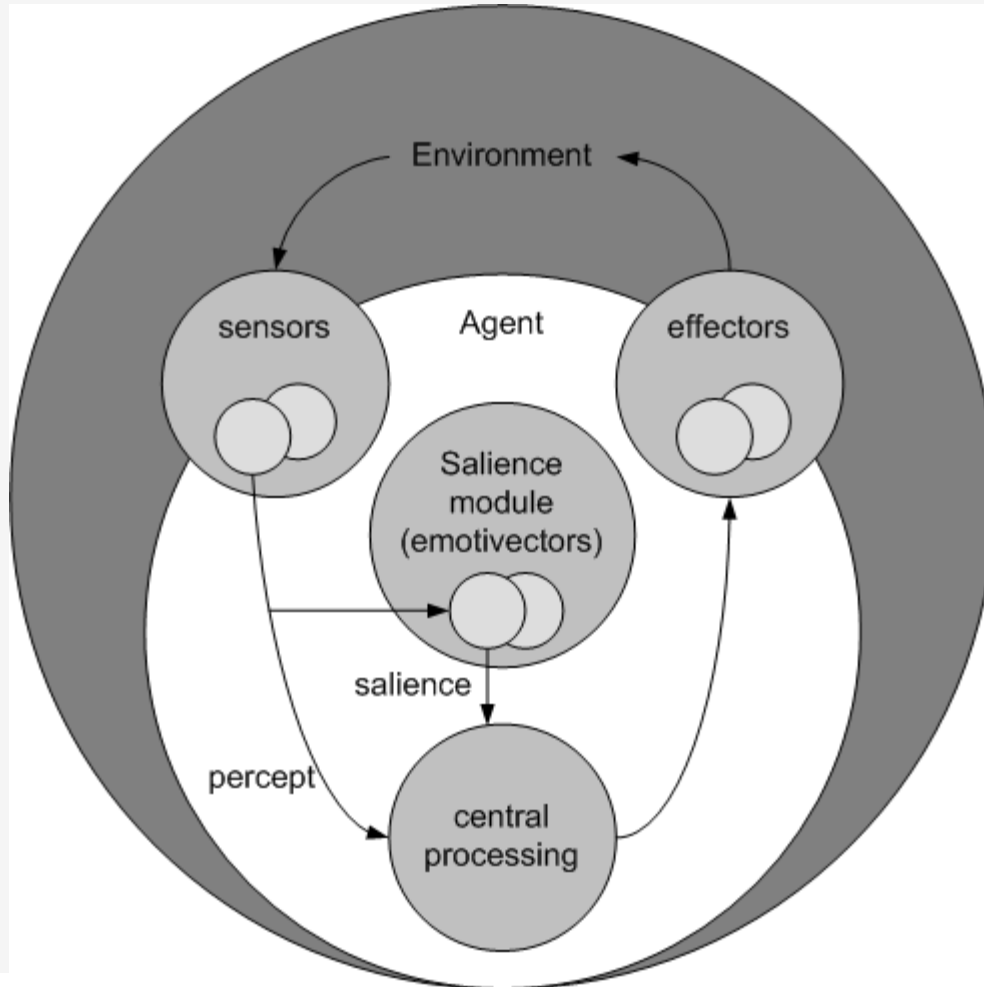
Yuppy



Emotivector

- Our *perceptions* guide our *attention*, which in turn affects our *perception*...
- Our *emotions* guide our *perception* that in turn affects our *emotions*....

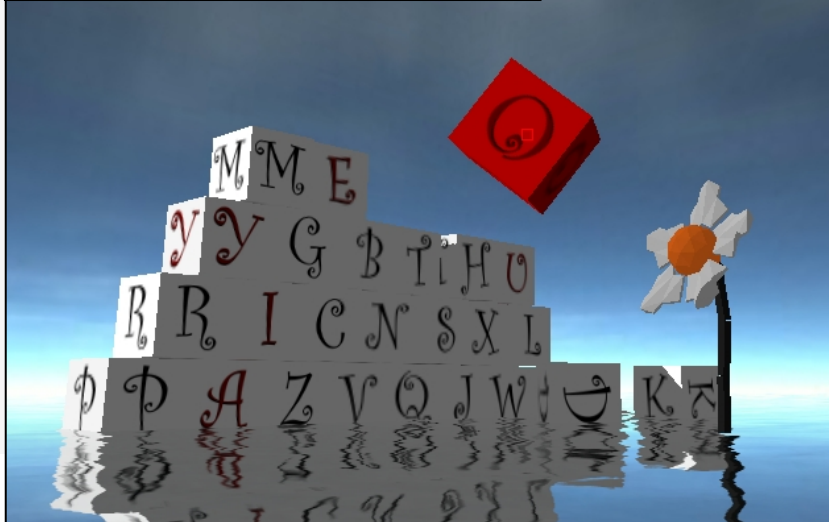
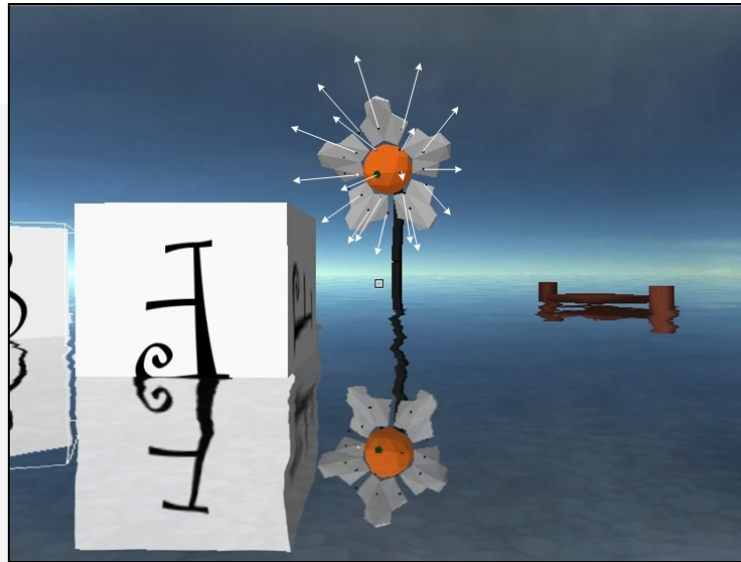
Emotivector



Percept Prediction
Anticipation model

Percept Salience
Attention model

Percept Sensation
Affective model

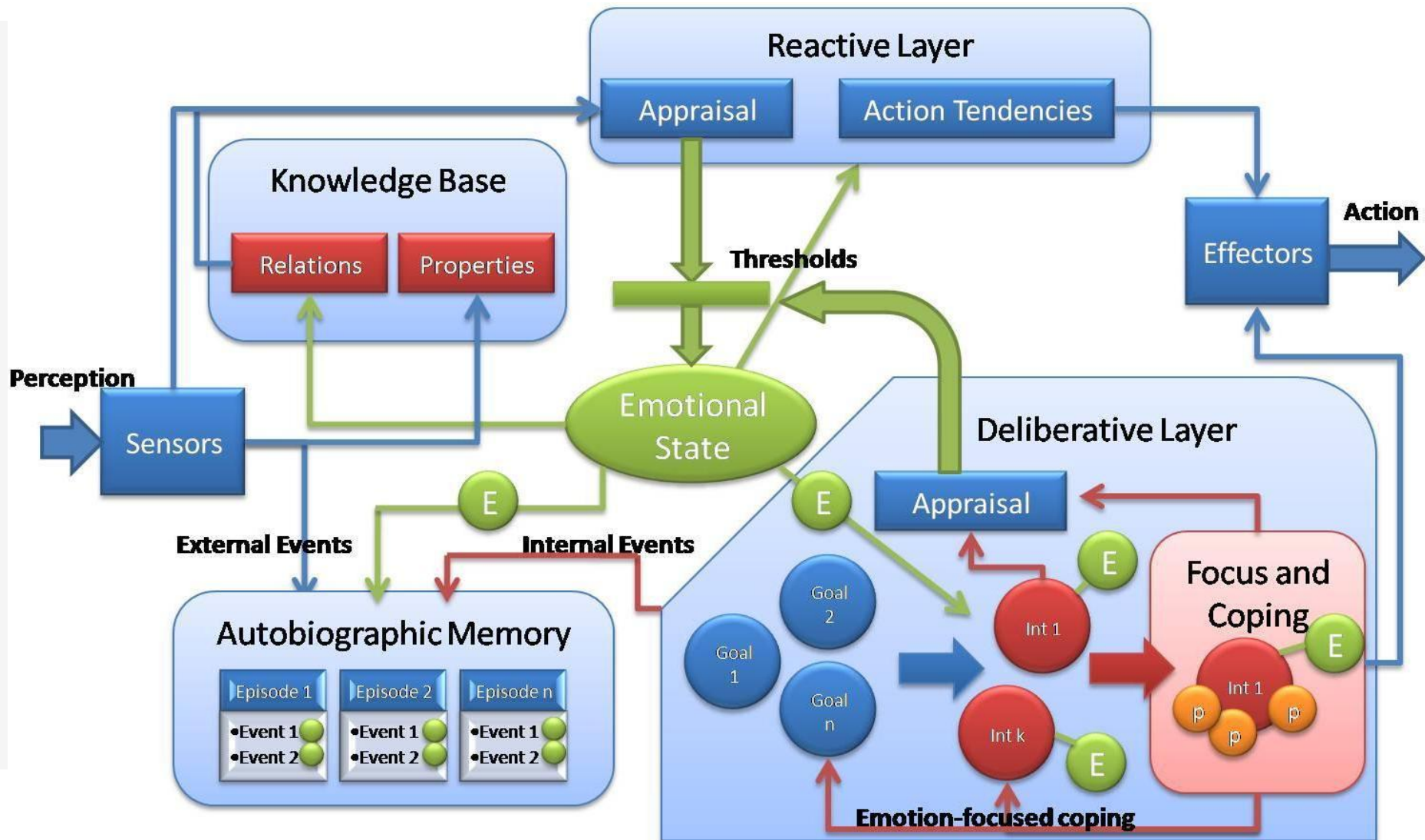






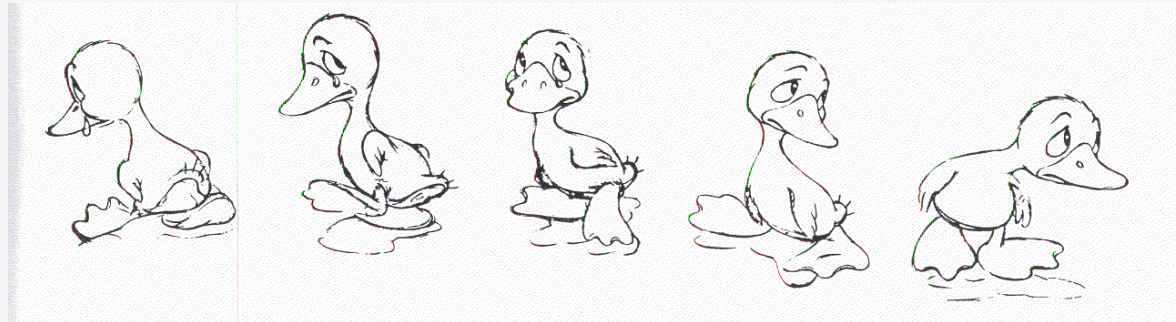
LIVING WITH ROBOTS
AND INTERACTIVE COMPANIONS

- Based on the **OCC** theory of Emotions
- Emotions are generated through an *appraisal* process
- Emotions affect:
 - *Reasoning*
 - *Planning*
 - *Actions*



Vision...

- We know that “scripted” animated characters can make users respond emotionally



- But can we create **autonomous characters** that also evoke emotional responses from users?

No, I can't

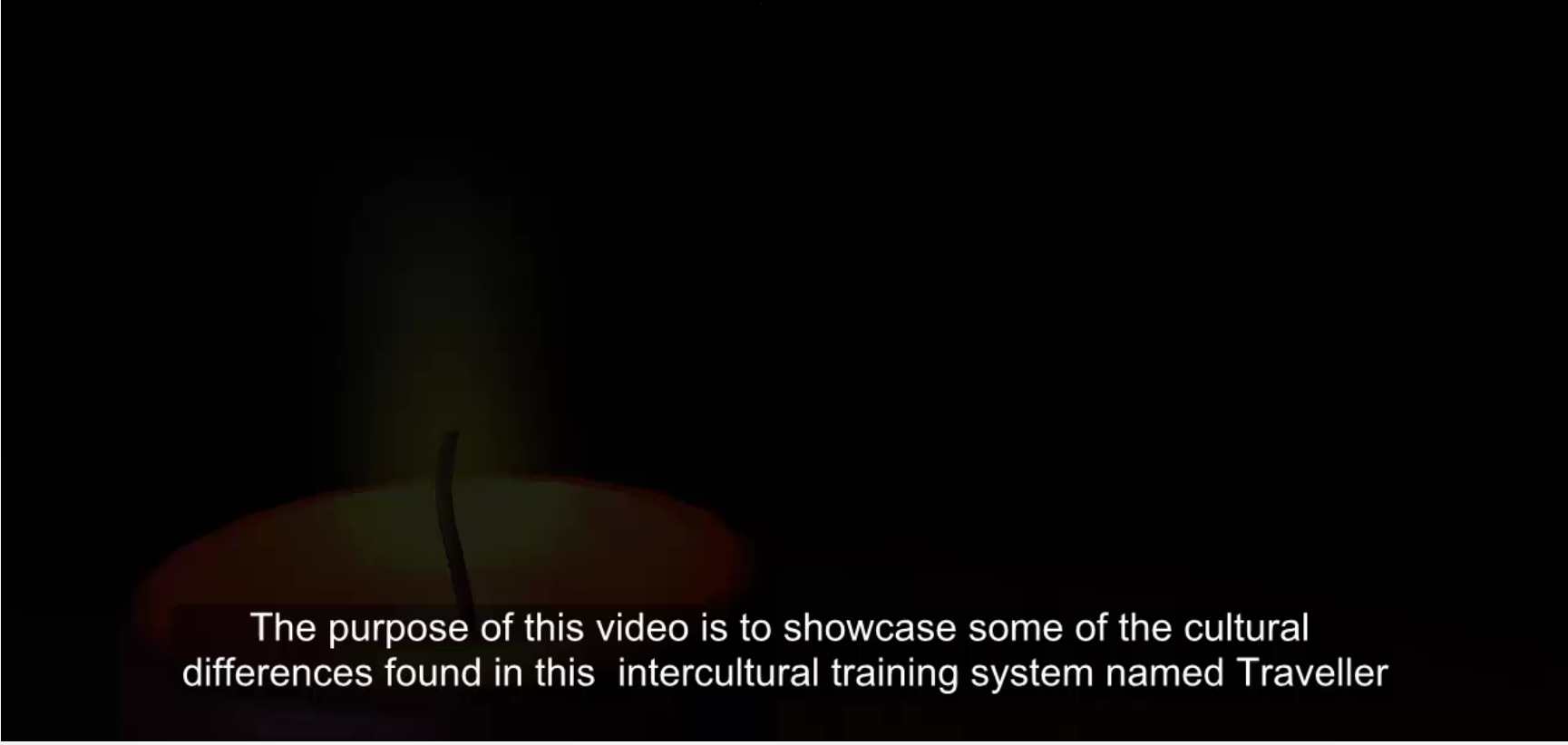
I will get hurt!

I can hit him



FearNot!

- Evaluated with 1000 children in Germany and UK
- Reduction of victimization rate



The purpose of this video is to showcase some of the cultural differences found in this intercultural training system named Traveller

Animating an emotional robot!

Socially Present Agents for Tabletop Games



Perguntas?